MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2022/2023 (TERM ID 2215)

PCH0016 – GENERAL CHEMISTRY

(Foundation in Engineering)

20 FEBRUARY 2023
9.00 a.m. –11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 4 pages (excluding front page) with 3 Questions in Section A and 3 Questions in Section B.

2. Attempt **all** questions. The distribution of marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

SECTION A: (14 MARKS)

Question 1

(a) According to the Periodic Table, does magnesium and sodium behave chemically the same or not? Explain your answers. [2 marks]

(b) Explain what is wrong with each of the statements below:

(i) Light is absorbed as electron moves from one energy level to a lower energy level. [1.5 marks]

(ii) Titanium (Z = 22) is in group 2B in the Periodic Table. [1.5 marks]

Question 2

(a) Give the name of the following phase transition processes:

(i) Iodine vapor changes to iodine crystals. [1 mark]

(ii) Solidifying of melted candle wax. [1 mark]

(b) Complete **Table AQ2b** below:

Table AQ2b

	Ionic crystal	Metallic crystal	Covalent crystal
Lattice point is occupied by:	(i)	(ii)	(iii)
Hardness	(iv)	(v)	(vi)

[3 marks]

Question 3

(a) According to Arrhenius concept, explain whether calcium hydroxide is acidic or basic. [2 marks]

(b) Label the acid, base, conjugate acid, and conjugate base for the following equation:

$$CN^- + H_2O \rightleftharpoons HCN + OH^-$$ [2 marks]

Continued...

SECTION B: (36 MARKS)

Question 1

(a) Given an element iron (Z=26).

(i) Draw the orbital diagram for iron without using a noble gas core. [1.5 marks]

(ii) State the number of unpaired electron that iron has. [0.5 mark]

(b) (i) Write a balanced chemical reaction equation for the reaction of sodium with oxygen gas. [1.5 marks]

(ii) Rank the following ions in the order of increasing atomic radius (from smallest to largest):

Na^{+} O^{2-} N^{3-} Mg^{2+} [1.5 marks]

(c) Draw the Lewis structure (Lewis–dot symbol) for the following compounds:

(i) $BeCl_2$ [2 marks]

(ii) MgI_2 [2 marks]

(d) Name the shape (molecular geometry) and give the AB_mE_n classification for the following compounds:

(i) CO_3^{2-} [2 marks]

(ii) PCl_5 [2 marks]

(e) For the following compound in **Figure BQ1e**:

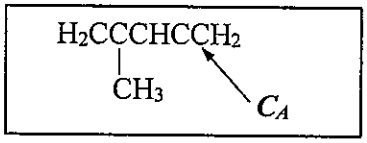

Figure BQ1e

(i) Predict the correct hybridization for the carbon atom, C_A, indicated in the molecule shown in **Figure BQ1e**. [1 mark]

(ii) Determine the number of sigma (σ) bonds and pi (π) bonds in the molecule. [1 mark]

Continued...

Question 2

(a) Which of the following substances are capable of hydrogen-bonding among themselves in the liquid state?

$CH_3CH_2CH_3$ HCN CO_2 CH_3CF_3 NF_3 [2 marks]

(b) The decomposition of nitramide (NH_2NO_2) below,

$$NH_2NO_2\,(aq) \rightarrow H_2O(l) + N_2O(g)$$

has a rate constant of $k = 7.0 \times 10^{-3}$ /min at 20°C. The initial concentration of NH_2NO_2 is 0.9 mol/L. Determine $[NH_2NO_2]$ after 5.0 hours. [2 marks]

(c) The following rate data were collected for the reaction:

$$2\,NO + 2\,H_2 \rightarrow N_2 + 2\,H_2O$$

Table BQ2c

Experiment	$[NO]_0$ (M)	$[H_2]_0$ (M)	$\Delta[N_2]/\Delta t$ (M/h)
1	1.20	0.30	0.20
2	1.20	0.60	0.40
3	1.20	1.20	0.80
4	2.40	1.20	3.20

Based on the information provided in **Table BQ2c**, determine the *rate law* for the experiment. [4 marks]

(d) Given the reaction:

$$2NO\,(g) + H_2(g) \rightleftharpoons N_2O(g) + H_2O(g) + \text{energy}$$

Determine the direction of equilibrium shift if the following changes are made:

(i) N_2O gas is added. [1 mark]

(ii) H_2 gas is removed. [1 mark]

Continued...

Question 3

(a) Calculate the H^+ and OH^- concentrations (in mol/L) for the solution with pH of 10.00 [2 marks]

(b) Rank the following acids in the order of increasing acid strength (from weakest to strongest):

HCl HI HF HBr [1 mark]

(c) Given that Metal X is more active than metal Y in the electrochemical series. Answer the following questions based on the voltaic cell diagram in **Figure BQ3c** below:

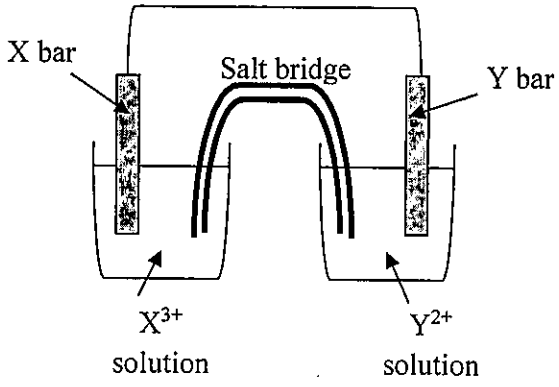

Figure BQ3c

(i) Write a balanced half-reaction at the anode. [1 mark]

(ii) Write a balanced half-reaction at the cathode. [1 mark]

(iii) Write a balanced overall redox reaction. [2 marks]

(iv) Identify the oxidizing agent. [1 mark]

(d) Determine the time (in minutes) requires to deposit 7.0 gram of solid Nickel on a metal object using a current of 8A. The Nickel is reduced from +2 oxidation state to 0.
(Faraday Constant: 96500 C/mol e^- ; Atomic mass Ni = 58.69) [3 marks]

End of Paper